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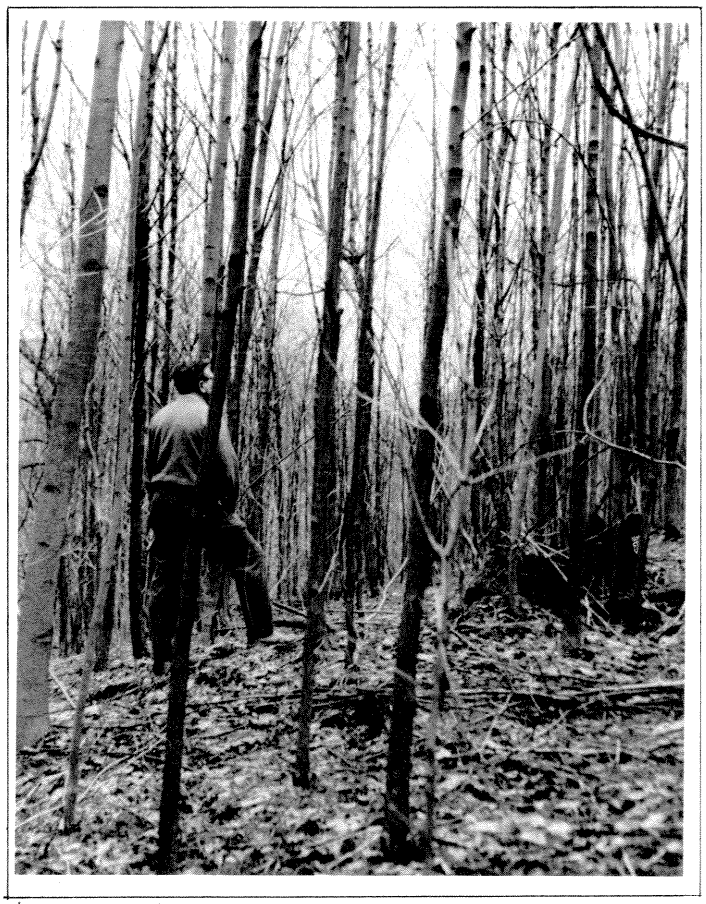
ODC 221.21 : 231 : 176.1

Reproduction 12 Years after Seed-tree Harvest Cutting in Appalachian Hardwoods



USDA FOREST SERVICE RESEARCH PAPER NE-350
1976

NORTHEASTERN FOREST EXPERIMENT STATION
FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
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MANUSCRIPT RECEIVED FOR PUBLICATION 24 DECEMBER 1975

ABSTRACT

Woody reproduction 12 years after a seed-tree harvest cutting was evaluated for three central Appalachian hardwood sites in West Virginia, including species composition; size, number, and distribution; stem quality; effects of early cultural treatments; and influence of grapevines. Reproduction ranged from 1,250 to 1,700 stems per acre in the 1.0 to 4.9 inch dbh size class. Partial estimates revealed that about 250 potential dominant and codominant crop trees per acre were present on oak site index 70 and about 500 on site index 60. Sweet birch, sugar maple, yellow-poplar, and black cherry were the most numerous species on the excellent sites; sugar maple, sassafras, red oak, red maple, and yellow-poplar on the good sites; and sassafras, red maple, red oak, chestnut oak, and sweet birch on the fair sites.

THIS IS A REPORT on reproduction in an Appalachian hardwood forest 12 years after a seed-tree harvest cutting. In the study, made on the Fernow Experimental Forest near Parsons, West Virginia, the following aspects of reproduction were studied:

1. Size, number, and distribution of stems.
2. Species composition.
3. Stem quality.
4. Effects of early cultural treatments.
5. Influence of grapevines.

This is the third report on this study. Reproduction was studied 3 years after cutting (*Wendel and Trimble 1968*) and again 7 years after cutting (*Trimble 1972*). The cutting practice used was an even-age treatment.

In this study, the reproduction data were stratified according to three site-quality classes for red oak (*Schnur 1937*). The results are applicable to central Appalachian hardwoods on site indexes (SI) of 60 or higher.

STUDY AREAS AND METHODS

This study was made on 9 compartments averaging 12 acres each. Three compartments were laid out on each of three classes of oak sites: SI 60 (fair site), SI 70 (good site), and SI 80 (excellent site). The three areas on a given site were not exact replicates because there was a difference in after-logging cultural treatments.

The soils on the study areas are medium-textured and well-drained, average more than 3 feet deep, and are derived largely from sandstone shale with occasional limestone influence. Annual precipitation averages about 58 inches and is well distributed throughout the year; the frost-free growing season is about 145 days.

Between 1905 and 1910 the study areas were logged heavily by commercial operators. Fires were numerous. The American chestnut died in the early 1930s, and most of the dead stems were logged before 1948.

All nine study areas contained a large proportion of sawtimber volume before the initial seed-tree cutting (table 1). Most of the sawtimber trees harvested on the three excellent sites were 90 to 100 years old. On the other sites, sawtimber trees were about 55 years old, with some older red oaks and sugar maples. Before treatment the study areas contained the following sawtimber species:

Excellent sites.—Sugar maple, red oak, white oak, black cherry, yellow-poplar, and hickory.

Good sites.—Yellow-poplar, red oak, hickory, chestnut oak, and white oak.

Table 1.—Average stand-per-acre data before the initial seed-tree cutting

Site class	Volume before cutting						Merchantable stems		Basal area in merchantable stems	
	Board-foot[a]			Cubic-foot[b]			5-10 inches dbh	11+ inches dbh	5-10 inches dbh	11+ inches dbh
	Merchantable	Cull	Total	Merchantable	Cull	Total				
	Board feet			*Cubic feet*			*No.*		*Sq. ft.*	
Excellent (SI 80)	21,088	631	21,719	3,822	117	3,939	59	72	20.7	115.6
Good (SI 70)	10,629	1,320	11,949	2,436	235	2,671	111	46	34.3	68.1
Fair (SI 60)	6,726	480	7,206	1,857	130	1,987	142	42	44.4	55.4

[a] Board-foot volume for trees 11.0 inches dbh to an 8.0-inch top dib merchantable height.
[b] Cubic-foot volume for trees 5.0 inches dbh to 4.0-inch dib merchantable height.

Fair sites.—Chestnut oak, red oak, black gum, and white oak. Species scientific names and tolerance ratings are listed at the end of this paper.

Seed-tree Harvest Treatment

The same harvest-cutting procedures were used on all study areas. Initially all stems over 5.0 inches dbh were logged except designated seed trees. On the better sites, 10 seed trees were retained per acre, on good sites 20, and on fair sites 30. Most of these seed trees were yellow-poplar, black cherry, red oak, white ash, and basswood on the better sites and oaks on the lower sites. Three growing seasons after logging, the seed trees were removed.

Within each site class, three types of cultural treatments were applied to the 1.0- to 4.9-inch stems: commercial, extensive, and intensive—as follows:

Commercial treatment.—No treatment of the 1.0- to 4.9-inch dbh stems planned until the next commercial cutting period, estimated at 20 years on the excellent site, 25 years on the good site, and 30 years on the fair site.

Extensive treatment.—One cultural operation involving the release of crop trees at 7 years after the original cutting on two compartments and at 9 years on one compartment.

Intensive treatment.—1.0- to 4.9-inch dbh residual stems were to be killed 3 years after the initial cutting. Living stems in two compartments were basal-sprayed with a mixture of 2,4,5-T and fuel oil at 20 pounds ahg. In a third compartment, the small stems were cut with a chain saw. At 7 years, crop trees were released in all compartments (*Trimble 1973 and 1974*).

Reproduction Surveys

In this study, commercial species were considered those that are normally marketed for veneer, sawlogs, posts, etc. Noncommercial species are those important primarily for esthetic or wildlife purposes.

Stem counts were made before the original harvest cutting, before and after the seed trees were removed at 3 years, and at the 7-year and 12-year periods. Reproduction tallies were made for commercial and noncommercial species. These included number of stems by species, size class, stem origin, and stocking.

Small reproduction included woody stems 1.0 foot high to 0.9 inch dbh. Large reproduction was defined as woody stems 1.0 inch to 4.9 inches dbh.

Small reproduction was sampled on permanent circular 0.001-acre plots (3.7-foot radius). Large reproduction was sampled on permanent 0.01-acre plots (11.8-foot radius). Plot centers were the same for both plot sizes. An average of 45 permanent plots was established within a 5-acre interior on each study area. Also, reproduction was tallied by crown class on four areas, using the crown class designation in Forest Terminology (*Society of American Foresters 1958*). A measure of the effect of the cultural treatment on residual stems was evaluated by using a stem-dominance estimate for each 0.01-acre plot.

Sprout stems were those originating from a stump that was at least 2 inches in diameter. Seedlings and seedling-sprouts were combined into the same class. Good-quality stems were those having desirable form, no rot, low stem origin, and relatively free of any noticeable superficial defects or injuries. Only the large reproduction was classed by quality.

The age of the study trees ranged from 12 to 15 years.

Grapevines

After the 1974 growing season, occurrence of grapevines was recorded on all areas, using the permanent 0.01-acre reproduction plots. This information included number of grapevines per acre and total number of woody stems with grapevines (*Smith and Lamson 1975*).

RESULTS

Though a seed-tree cutting practice was used, silviculturists in this locale generally believe that it is not necessary to leave seed trees to supply seed for purposes of regeneration.

Table 2.—Status of average small commercial reproduction 12 growing seasons after a seed-tree harvest cutting

Site class	Total stems	Sprouts	Percentage of sprouts	Percentage of plots stocked (total stems)
	- *Number per acre* -		*Percent*	*Percent*
Excellent (SI 80)	4,792	266	5.9	88.2
Good (SI 70)	4,081	777	19.6	82.2
Fair (SI 60)	3,716	583	16.3	83.7

Table 3.—Average species composition and periodic development of small reproduction at 3, 7, and 12 years for 3 site classes

[Reproduction 1.0 foot high to 0.9 inch dbh]

At 3 years		At 7 years		At 12 years	
Species	Per acre	Species	Per acre	Species	Per acre
	No.		*No.*		*No.*
		EXCELLENT SITE			
Sugar maple	3,909	Sweet birch	3,124	Sugar maple	2,059
Sweet birch	3,530	Sugar maple	2,617	Sweet birch	1,304
White ash	1,399	Yellow-poplar	1,158	White ash	408
Yellow-poplar	1,288	White ash	1,089	Black cherry	356
Black cherry	1,244	Black cherry	994	Yellow-poplar	252
Hickory	363	E. hophornbeam	518	Elm	133
Others	1,605	Basswood	303	Hickory	74
- -	- -	Hickory	296	Basswood	66
- -	- -	Others	642	Others	140
Total	13,338	Total	10,741	Total	4,792
		GOOD SITE			
Sugar maple	2,540	Sugar maple	1,970	Sugar maple	1,852
Yellow-poplar	1,881	Yellow-poplar	696	White ash	400
Sassafras	1,273	Sassafras	600	Yellow-poplar	348
Red oak	659	Sweet birch	356	Red oak	252
White ash	642	Red maple	348	Red maple	185
Black locust	526	White ash	289	Hickory	185
Black cherry	518	Red oak	259	Sweet birch	170
Sweet birch	466	Black cherry	259	Black cherry	156
Others	1,678	Others	1,208	Others	533
Total	10,183	Total	5,985	Total	4,081
		FAIR SITE			
Sassafras	5,544	Sassafras	2,664	Red maple	693
Chestnut oak	1,992	Sweet birch	1,372	Sweet birch	682
Red maple	1,820	Red maple	1,103	Red oak	594
Sweet birch	1,518	Chestnut oak	1,044	Blackgum	437
Sourwood	926	Blackgum	556	Chestnut oak	405
Red oak	785	Red oak	413	Sassafras	390
- -	- -	White oak	277	Black cherry	166
- -	- -	- -	- -	Yellow-poplar	157
Others	1,019	Others	752	Others	192
Total	13,604	Total	8,181	Total	3,716

Small Reproduction

After 12 years, about 4,000 small stems were present per acre on all sites, and about 85 percent of the 0.001-acre plots were stocked with a commercial species. Stems of sprout origin ranged from about 6 to 20 percent (tables 2 and 3).

At 3 and 7 years there was little change among the most numerous species on each site. At 12 years these species were still similar on the excellent site, but sassafras was dropping out on the lower sites. The number of small stems per acre on all plots decreased between the 3-year and 12-year measurement periods.

At 12 years sugar maple and sweet birch accounted for 70 percent of the total number of commercial stems on the excellent site; sugar maple (45 percent) on the good sites; and red maple, sweet birch, and red oak (52 percent) on the fair sites (table 3). Intermediate to intolerant species including red oak, white ash, basswood, yellow-poplar, and black cherry, averaged about 25 percent of the total number of small stems present. However, experience indicates that many of the intolerant species in this small class die and will not respond if released.

The stocking of small reproduction on the 0.001-acre plots at 12 years averaged 88 percent on the excellent sites and 82 to 84 percent on the good and fair sites (table 2). At 7 years the stocking of small reproduction was between 93 and 97 percent for all three sites.

Large Reproduction

Number of stems per acre.—Because there were no consistent trends due to cultural treatment, data for all three study areas in each site class were combined. General information on sprouting, quality, and stocking were summarized (table 4). Excellent and fair sites averaged about 1,700 large stems per acre after 12 years, and good sites averaged 1,250 stems per acre (fig. 1).

Figure 1.—Some of the 12-year-old reproduction after a seed-tree cutting on an excellent hardwood site (oak site 80).

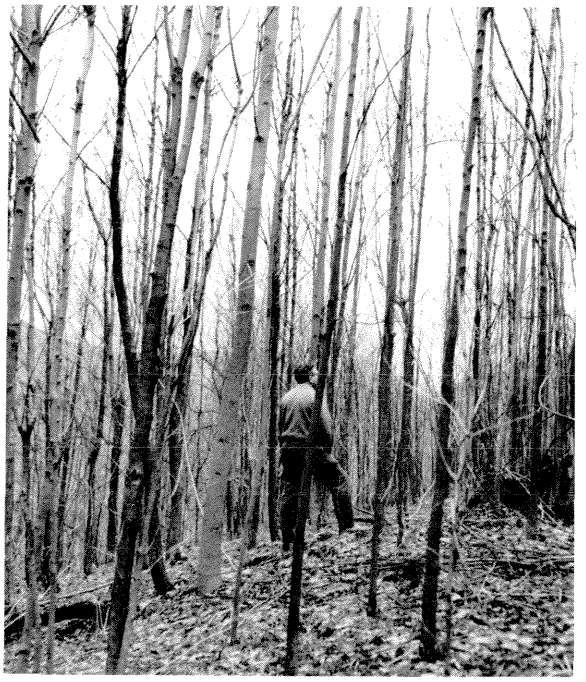


Table 4.—Status of large commercial reproduction 12 growing seasons after a seed-tree harvest cutting

Site class	Total stems	Total sprouts	Total good stems		Percentage of good seedling stems	Percentage of sprouts (includes good and poor stems)	1/100-acre plots stocked
			Seedlings	Sprouts			
	No.	*No.*	*No.*	*No.*	*Pct.*	*Pct.*	*Pct.*
Excellent (SI 80)	1,794	334	1,032	166	57.5	18.6	99.3
Good (SI 70)	1,248	581	294	175	23.6	46.6	100.0
Fair (SI 60)	1,653	821	489	396	29.6	49.7	100.0

On the excellent site, sweet birch, yellow-poplar, sugar maple, and black cherry accounted for about 800 good stems per acre or about 67 percent of the good stems (table 4). On the good site, sassafras, black locust, sugar maple, red maple, and black cherry accounted for about 250 good stems per acre (53 percent). On the fair site, good-quality sassafras, red maple, sweet birch, red oak, and chestnut oak totalled 777 good stems per acre or about 88 percent of the good stems.

About half of the total large reproduction on the good and fair sites was of sprout origin. However, on the excellent sites less than 20 percent of the stems were of sprout origin. This was not surprising because the excellent sites had older trees when logged, and older stumps usually sprout less fre-

Table 5.—Average species composition and periodic development of large reproduction at 3, 7, and 12 years on 3 site classes

[Reproduction 1.0 to 4.9 inches dbh]

At 3 years		At 7 years		At 12 years	
Species	Per acre	Species	Per acre	Species	Per acre
	No.		*No.*		*No.*
		EXCELLENT SITE			
Sugar maple	46	Sugar maple	91	Sweet birch	518
Basswood	18	Basswood	49	Sugar maple	247
Beech	12	E. hophornbeam	43	Yellow-poplar	236
Elm	6	Black locust	38	Black cherry	158
Cucumbertree	4	Black cherry	27	E. hophornbeam	137
Sweet birch	3	Sweet birch	25	White ash	96
—	—	Hickory	22	Basswood	92
—	—	Red oak	19	Black locust	79
—	—	Yellow-poplar	14	Red oak	65
Others	7	Others	34	Others	167
Total	96	Total	362	Total	1,795
				Intermediate-intolerants	647
		GOOD SITE			
Sugar maple	73	Black locust	124	Sugar maple	184
Beech	24	Sugar maple	111	Sassafras	148
Red maple	24	Red maple	107	Red maple	142
Hickory	16	Sassafras	97	Red oak	124
White oak	12	Red oak	91	Yellow-poplar	118
Black cherry	10	Yellow-poplar	75	Black locust	95
Yellow-poplar	7	Black cherry	49	Black cherry	89
—	—	Basswood	39	Sweet birch	76
Others	30	Others	179	Others	272
Total	196	Total	872	Total	1,248
				Intermediate-intolerants	303
		FAIR SITE			
Red maple	89	Red maple	204	Sassafras	483
Sweet birch	39	Sassafras	176	Red maple	372
Sugar maple	15	Chestnut oak	103	Red oak	184
Sassafras	13	Red oak	84	Chestnut oak	184
Beech	11	Sourwood	49	Sweet birch	169
Chestnut oak	10	Sweet birch	33	Sourwood	70
—	—	Sugar maple	27	—	—
Others	33	Others	98	Others	191
Total	210	Total	774	Total	1,653
				Intermediate-intolerants	214

quently than younger stumps (*Wendel 1975*). The major sprouting species on all sites were red maple, sugar maple, red and chestnut oaks, basswood, and sassafras.

Periodic species composition.—As expected, the number of large stems changed considerably during the 12-year period (table 5). On the excellent sites sweet birch, yellow-poplar, and black cherry have moved rapidly into this large reproduction category between the 7th and 12th years. Sugar maple was present in large numbers throughout all measurement periods. On the good site, sugar maple, red maple, yellow-poplar, and black cherry were abundant at each measurement period; and most species except black locust increased in number. On the fair site, species composition was similar. The development of red oak, chestnut oak, and sassafras, and the consistency of red maple and sweet birch were readily apparent.

At the 12-year period, sugar maple occurred in large quantities on both good and excellent sites, as did red maple and sassafras on the good and fair sites. Sweet birch occurred on all three sites. Also, on the excellent site more than one-third of the stems present after 12 years were intermediate-intolerant species (yellow-poplar, red oak, black cherry, basswood, and white ash) while the good sites had about one-fourth and the fair sites one-eighth of the stems in this intermediate-intolerant category.

On the good site, about 250 stems were classed as good dominant or codominant stems. About 500 stems were judged as good dominant-codominant stems for one sample area on the fair site. The excellent site areas were not sampled. A summary of individual species crown classes (table 6) revealed that on the good sites black locust and yellow-poplar had an average of 40 and 30 good dominant and codominant stems per acre while black cherry and red oak averaged about 20 stems per acre. On the fair site chestnut oak, red maple, and sassafras had

Table 6.—Summary of individual species per acre by crown and quality class for good and fair sites

[Large stems — 1.0 inch to 4.9 inches dbh]

Species	Dominant-codominant		Intermediate-overtopped	
	Good[a]	Poor[a]	Good	Poor
	No.	*No.*	*No.*	*No.*
	GOOD SITE (SI 70)			
Black locust	40	11	11	34
Yellow-poplar	30	7	23	59
Sassafras	29	20	35	64
Red maple	26	8	24	85
Sweet birch	22	6	16	32
Black cherry	20	6	17	46
Red oak	19	13	25	68
Sugar maple	16	13	46	109
Chestnut oak	12	2	5	16
Others	24	19	31	160
Total	238	105	233	673
	FAIR SITE (SI 60)			
Red maple	125	32	66	141
Chestnut oak	122	66	34	100
Sassafras	102	48	100	211
Red oak	68	45	23	75
Sweet birch	23	5	14	9
Others	53	65	31	146
Total	493	261	268	682

[a] Estimates of stem quality. All 3 areas were sampled on the good site; only 1 area was sampled on the fair site; no areas were sampled on the excellent site.

more than 100 good dominant-codominant stems per acre while red oak had 70 stems.

Occurrence.—After 12 years nearly all study areas had at least one large commercial stem present on each reproduction plot (table 4). At 7 years only the good and fair sites had approached 100-percent stocking, while the excellent sites had averaged 85 percent of plots stocked with at least one large stem.

Grapevines

Grapevines (summer grape and silverleaf grape) are rapidly becoming a major problem in young even-aged Appalachian hardwood stands (fig. 2). They damage reproduction by reducing stem quality through bending, breaking or uprooting the stems, reducing growth, or causing death. In association with snow and freezing rain, grapevine damage increases drastically (*Trimble and Tryon 1974*). In February 1975 we estimated the number of grapevines on all study areas and counted the number of saplings with grapevines in their crowns (*Smith and Lamson 1975*).

On the three good sites, grapevines averaged about 900 stems per acre, and nearly 75 percent of the saplings had grapevines in their crowns (table 7). On the excellent sites, about 450 vines were present per acre, and about 50 percent of the saplings had grapevines in their crowns. The fair site averaged 16 vines per acre, but two areas had fewer than 10 vines per acre, and only about 2 percent of the saplings had grapevines in their crowns.

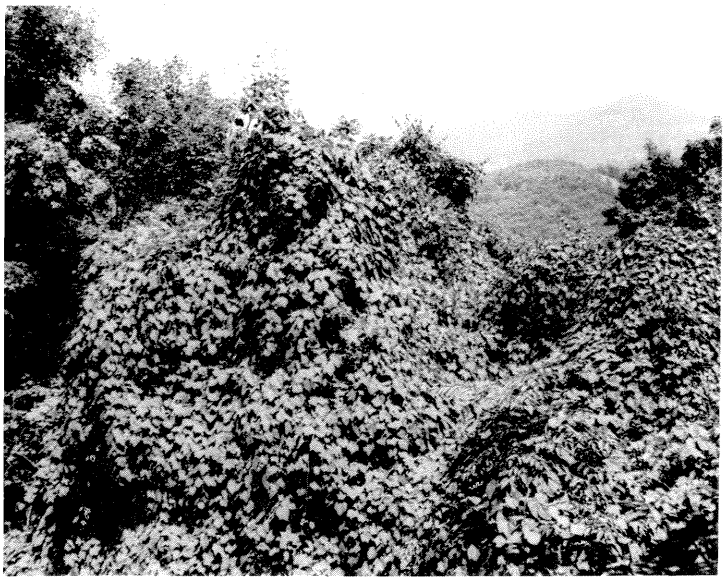
Table 7.—Assessment of grapevines 12 to 15 years after a seed-tree cutting on fair, good, and excellent oak sites

Site class	Reproduction stems 1.0 inch dbh and larger			
	Grapevines per acre	Stems[a] per acre	Stems per acre with grapevines[b]	
	No.	*No.*	*No.*	*Pct.*
Excellent (SI 80)	457	2,065	993	47.7
Good (SI 70)	895	1,512	1,115	73.7
Fair (SI 60)	16	1,902	44	2.3

[a] Includes both commercial and noncommercial stems.

[b] Stem considered to have grapevines if a vine was touching crown branches.

Figure 2.—Grapevines have become a major problem in managing young hardwood stands. Left, a mass of grapevines covering the crowns of young trees. Right, a winter view reveals the mat of vines.



Grapevine damage is increasing rapidly on the better sites. Unless control measures are taken, the excellent sites will soon have fewer good stems suitable for crop trees. The good sites averaged nearly twice as many grapevines per acre as the excellent sites—895 to 457. Sapling quality on the good sites was lower than that on the excellent sites largely because of grapevines. About 50 percent of the saplings on the fair site were of poor quality, but grapevines were not the main cause of poor quality on these sites.

We do not consider the difference in site quality to be the reason for a higher number of grapevines on the good sites than on the excellent sites. We speculate that this difference resulted from some past occurrence in the stand.

Noncommercial Reproduction after 12 Growing Seasons

Noncommercial species include American chestnut, pin cherry, flowering dogwood, serviceberry, striped maple, and American hornbeam. Noncommercial stems occurring on the three sites were mainly striped maple, flowering dogwood, and American chestnut sprouts (table 8). The number of small noncommercial reproduction stems per acre averaged 215 for the excellent site, 607 for the good site, and 584 for the fair site. The number of large stems present on all three sites was similar—110 to 169 stems per acre. On the fair sites, many large American chestnuts were present at 12 years (129 per acre); however about 70 percent had the chestnut blight. All chestnuts are expected to die within a few years. Presently the dying chestnuts are serving and will serve to promote natural thinning, especially on the fair sites.

Effects of Early Cultural Treatments

Within each site class, three cultural treatments were applied—commercial, extensive, and intensive. For the commercial treatment —residual stems left after logging were not treated; extensive—crop trees were released at 7 years except for one area where the trees were released at 9 years; intensive—advanced regeneration was removed at 3 years and crop trees selected and released at 7 years. The effects of these treatments were observed on the 0.01-acre plots to determine if the

Table 8.—Small and large noncommercial reproduction 12 growing seasons after a seed-tree cutting on 3 oak site classes

Excellent site (SI 80)		Good site (SI 70)		Fair site (SI 60)	
Species	Average per acre	Species	Average per acre	Species	Average per acre
	No.		*No.*		*No.*
SMALL STEMS, 1.0 FOOT TO 0.9 INCH DBH					
Striped maple	163	Flowering dogwood	296	American chestnut	196
Sumac	30	American chestnut	96	Serviceberry	196
Flowering dogwood	15	Serviceberry	96	Striped maple	163
American chestnut	7	Striped maple	89	Flowering dogwood	22
—	—	American hornbeam	30	Pin cherry	7
Others	0	Others	0	Others	0
Total	215	Total	607	Total	584
LARGE STEMS, 1.0 INCH DBH TO 4.9 INCHES DBH					
Striped maple	77	Flowering dogwood	34	American chestnut	129
Pin cherry	29	American chestnut	26	Serviceberry	25
Flowering dogwood	5	Serviceberry	24	Striped maple	10
American chestnut	1	Pin cherry	14	Pin cherry	5
—	—	Striped maple	12	—	—
Others	0	Others	0	Others	0
Total	112	Total	110	Total	169

plots were dominated by residual stems left after logging.

On the three commercially treated areas, residual stems dominated 13 to 50 percent of the area. Results from the extensively treated areas varied to a lesser degree than the commercially treated areas. Ten to 25 percent of the new reproduction was dominated by residual stems. From the intensive cultural treatment we did not expect any of the residual stems to be dominating the new reproduction. One area was as expected because all advanced stems were cut at the 3-year period. However, on two areas residual stems were dominating between 15 and 20 percent of the area. These stems were supposed to have been basal-sprayed at 3 years. Some residual stems were missed, but many that were treated did not die.

Some residual stems were 9 inches dbh 12 years after the seed-tree harvest. We observed that sugar maple was the most vigorous species with good stem form. In our opinion, the results of the cultural treatments were too variable, and the intensive and extensive treatments so similar, that one must question the effectiveness of the cultural practices on development of reproduction. In later years we plan to complete thinnings by using different basal-area guidelines at 20, 25 and 30 years depending on cultural treatment and site class.

SUMMARY

The status of reproduction after seed-tree cutting on three oak sites (excellent SI 80, good SI 70, and fair SI 60) for 12-year-old even-aged West Virginia central Appalachian hardwood stands can be summarized this way:

Small Reproduction

(1 foot high to 0.9 inch dbh)

- Averaged about 4,000 stems per site class.
- 85 percent of the milacres were stocked with commercial woody species.
- Sprout-origin stems ranged from 6 to 20 percent.
- Sugar maple and sweet birch were predominant on the good and excellent sites; red maple, sweet birch, and red oak on the fair site.
- Main noncommercial species were striped maple, flowering dogwood, and American chestnut sprouts. All the chestnuts are expected to die.

Large Reproduction

(1.0 to 4.9 inches dbh)

- After 12 years, the large reproduction will provide most of the future sawtimber crop trees.
- Numbers of desirable species were more than adequate for future stand management.
- Stands averaged 1,250 to 1,700 commercial stems per acre.
- On the fair and good sites about 500 and 250 stems were judged as good dominant-codominant stems.
- About 50 percent of the total reproduction was sprout origin on the good and fair sites. Excellent sites averaged 20 percent, but this is explained by the cutting of older trees during logging.
- Nearly all of the 0.01-acre sample plots were stocked with a commercial species.
- Sweet birch, sugar maple, yellow-poplar, and black cherry were the most numerous species on the excellent sites; sugar maple, sassafras, red oak, red maple, and yellow-poplar on the good sites; sassafras, red maple, red oak, chestnut oak, and sweet birch on the fair sites.
- One-third of the commercial stems on the excellent sites, one-fourth on good sites, and one-eighth on fair sites were yellow-poplar, black cherry, red oak, basswood, and white ash.
- Noncommercial species ranged from an average of 110 to 169 stems per acre for the three site classes.
- Major noncommercial species were striped maple, serviceberry, American chestnut,

dogwood, and pin cherry. About 70 percent of the chestnuts were blighted.

General

- In this locale, grapevine development on the better sites (oak SI 70 and 80) is a major deterrent to the development of future sawtimber in these young even-aged stands.
- Average number of grapevines ranged from 16 per acre on the fair sites to 900 per acre on the better sites.
- Residual stems dominated a smaller portion of reproduction from the extensive and intensive treatments than from the commercial cultural treatment. However, these results were so variable that the effects of early cultural treatments are uncertain.

These results indicate what is happening to the species composition after the seed-tree cutting treatment. No doubt there is more than adequate quality reproduction on all sites. However, grapevines are seriously hampering the stem and quality development on the better sites. After 12 years, stems present in the large reproduction class will be the major source for the future dominant canopy. The results indicate there is such a variety of species present on each area that most foresters should have little difficulty manipulating these stands to their individual objectives.

Table 9.—Species referred to in this study

Common name	Scientific name
Ash, white	*Fraxinus americana* L.
Aspen, bigtooth	*Populus grandidentata* Michx.
Basswood	*Tilia americana* L.
Beech, American	*Fagus grandifolia* Ehrh.
Birch, sweet	*Betula lenta* L.
Chestnut, American	*Castanea dentata* (Marsh.) Borkh.
Cherry, black	*Prunus serotina* Ehrh.
Cherry, pin	*Prunus pensylvanica* L. f.
Cucumbertree	*Magnolia acuminata* L.
Dogwood, flowering	*Cornus florida* L.
Elm, slippery	*Ulmus rubra* Muhl.
Grape, summer	*Vitis aestivalis* Michx.
Grape, silverleaf	*Vitis aestivalis* var. *argentifolia* [Munson] Fern
Gum, black	*Nyssa sylvatica* Marsh.
Hickory	*Carya* spp.
Hophornbeam, eastern	*Ostrya virginiana* (Mill.) K. Koch
Hornbeam, American	*Carpinus caroliniana* Walt.
Locust, black	*Robinia pseudoacacia* L.
Magnolia, Fraser	*Magnolia fraseri* Walt.
Maple, red	*Acer rubrum* L.
Maple, striped	*Acer pensylvanicum* L.
Maple, sugar	*Acer saccharum* Marsh.
Oak, black	*Quercus velutina* Lam.
Oak, chestnut	*Quercus prinus* L.
Oak, northern red	*Quercus rubra* L.
Oak, scarlet	*Quercus coccinea* Muenchh.
Oak, white	*Quercus alba* L.
Sassafras	*Sassafras albidum* (Nutt.) Nees.
Serviceberry, downy	*Amelanchier arborea* (Michx. f.) Fern.
Sourwood	*Oxydendrum arboreum* (L.) DC.
Yellow-poplar	*Liriodendron tulipfera* L.

Table 10.—Tolerance ratings for central Appalachian hardwood species[a]

Species	Tolerance rating				
	Very tolerant	Tolerant	Intermediate	Intolerant	Very intolerant
Eastern hophornbeam	X				
American beech	X				
Sugar maple	X				
Flowering dogwood	X				
Red maple		X			
Sweet birch		X			
Fraser magnolia			X		
Cucumbertree			X		
White ash			X		
Basswood			X		
Black gum			X		
Yellow birch			X		
White oak			X		
Northern red oak			X		
Black oak			X		
Chestnut oak			X		
Slippery elm			X		
Hickories			X		
Downy serviceberry			X		
Sourwood			X		
Scarlet oak				X	
Butternut				X	
Yellow-poplar				X	
Sassafras				X	
Black cherry				X	
Bigtooth aspen					X
Black locust					X
Pin cherry					X

[a] Trimble, George R., Jr. SUMMARIES OF SOME SILVICAL CHARACTERISTICS OF SEVERAL APPALACHIAN HARDWOOD TREES. USDA For. Serv. Gen. Tech. Rep. NE-16. 5 p. 1975.

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